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FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	
71980/56667	
U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR	
10/019749	

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE/00/01888	06/07/00	06/24/99

TITLE OF INVENTION

SHANK-END TOOL WITH PERMANENTLY ATTACHED WINGLIKE INSERTS

APPLICANT(S) FOR DO/EO/US

Actech GmbH, Advanced Casting Technologies Gießereitechnologie

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☒ are attached hereto (required only if not communicated by the International Bureau).
   b. ☒ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☒ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☒ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☒ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

PCT Form IB 301, PCT Form IB 304, PCT Form RO/101, WO 01/00351 A1 Cover page, redline version of substitute specification, Figure 1.

PCTUS1/REV03

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/019749	PCT/DE/00/01888	71980/56667

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		CALCULATIONS PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1040.00	
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$890.00	
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$740.00	
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$710.00	
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =		$890.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	20 - 20 =	0	x $18.00	$0.00
Independent claims	2 - 3 =	0	x $84.00	$0.00
Multiple Dependent Claims **(check if applicable).**			☐	$0.00

TOTAL OF ABOVE CALCULATIONS =	$890.00
☒ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.	$445.00
SUBTOTAL =	$445.00
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +	$0.00
TOTAL NATIONAL FEE =	$445.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☒	$40.00
TOTAL FEES ENCLOSED =	$485.00
Amount to be: refunded	$
charged	$

a. ☒ A check in the amount of **$485.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **04-1105** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

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REGISTRATION NUMBER

21 Dec 01
DATE

Attorney Docket No. 71980/56667

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Rüdiger Hauschild et al.

SERIAL NO. National Stage of PCT/DE/00/01888

FILED: Herewith

FOR: SHANK-END TOOL WITH PERMANENTLY ATTACHED WING-LIKE INSERTS

BOX PATENT APPLICATION
COMMISSIONER FOR PATENTS
WASHINGTON, DC 20231

Sir:

PRELIMINARY AMENDMENT

Please amend the above application as follows.

In the Specification:

The specification has been amended to include sub headings, to remove reference to patent claims and substitute the wording of the original claims. Also the term "non-cutting blade edge (12)" as translated into English has been replaced with the term --wear resistant cutting blade edge (12)-- because the translated term does not accurately connote the technological sense of the term taken in the context of the disclosure. A substitute specification is enclosed. No new matter has been added.

In the Claims:

Please cancel claims 1-10 and enter the following new claims.

11. A shank-end tool for the milling-type machining of chipless materials for the manufacture of molds, especially heat-resistant casting molds for producing metal castings, said tool comprising:

a shank portion having a longitudinal axis, a first end that can be connected detachably to a drive device and a second end with a groove-shaped recess extending in the longitudinal direction; and

a cutter blade in said groove and fixedly attached to the shank, said cutter blade having a flat leading face in a direction of advance during use,

wherein the cutter blade is provided with a wear resistant blade edge on the leading face.

12. A shank-end tool in accord with Claim 11, wherein the cutter blade is a flat blank of a material selected from the group consisting of steel, wear-resistant steel, or a wear-resistant material, and wherein said blade edge is at a right angle to the flat leading face.

13. A shank-end tool in accord with Claim 11, cutter blade further comprising a trailing edge behind the blade edge when viewed in the direction of advance, wherein the blade edge and the trailing edge are rounded.

14. A shank-end tool in accord with Claim 11, wherein the flat leading face of the cutter blade has a rounded corner or a corner cut at an angle.

15. A shank-end tool in accord with Claim 11, wherein the flat leading face of the cutter blade has an outer contour with a circular arc or conical shape.

16. A shank-end tool in accord with Claim 11, the cutter blade further comprises a curved surface having a convex face or a bent surface, parallel to the longitudinal axis, with the convex face of the curved surface or of the bend pointing in a direction of rotation of the shank in use.

17. A shank-end tool in accord with Claim 11, wherein the cutter blade further comprises shovel-like blade folds that are sloped with a blade angle relative to the longitudinal axis to produce fan-like action.

18. A shank-end tool in accord with Claim 11, wherein the cutter blade comprises a material selected from the group consisting of a metal, a high-strength elastically deformable material, and a springy material.

19. A shank-end tool in accord with Claim 11, wherein the cutter blade comprises a steel base material and is provided with a wear-protective covering on the leading flat face, the wear-protective covering being a material selected from the group consisting of a hard substance, a metal composite containing hard substances. and a metal alloy containing a hard substance.

20. A shank-end tool in accord with Claim 11, wherein the shank comprises a tubular or cylindrical hollow body at least at the second end.

21. A method for the milling-type machining of chipless materials for the manufacture of heat-resistant molds, said method comprising:

providing a shank-end tool comprising:

a shank portion having a longitudinal axis, a first end that can be connected detachably to a drive device and a second end with a groove-shaped recess extending in the longitudinal direction; and

a cutter blade in said groove and fixedly attached to the shank, said cutter blade having a flat leading face in a direction of advance during use,

wherein the cutter blade is provided with a wear resistant blade edge on the leading face:

machining a chipless material with the shank-end tool to provide a finished form.

22. A method for the milling-type machining of chipless materials in accord with claim 21, wherein the cutter blade is a flat blank of a material selected from the group consisting of steel, wear-resistant steel, or a wear-resistant material, and wherein said blade edge is at a right angle to the flat leading face.

23. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade further comprises a trailing edge behind the blade edge when viewed in the direction of advance, wherein the blade edge and the trailing edge are rounded.

24. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the flat leading face of the cutter blade has a rounded corner or a corner cut at an angle.

25. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the flat leading face of the cutter blade has an outer contour with a circular arc or conical shape.

26. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade further comprises a curved surface having a convex face or a bent surface, parallel to the longitudinal axis, with the convex face of the curved surface or of the bend pointing in a direction of rotation of the shank in use.

27. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade further comprises shovel-like blade folds that are sloped with a blade angle relative to the longitudinal axis to produce fan-like action.

28. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade comprises a material selected from the group consisting of a metal, a high-strength elastically deformable material, and a springy material.

29. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade comprises a steel base material and is provided with a wear-protective covering on the leading flat face, the wear-protective covering being a material selected from the group consisting of a hard substance, a metal composite containing hard substances. and a metal alloy containing a hard substance.

30. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the shank comprises a tubular or cylindrical hollow body at least at the second end.

REMARKS

An early examination and notice of allowance are earnestly solicited. Should the Examiner wish to discuss any of the amendments and/or remarks made herein, the undersigned attorney would appreciate the opportunity to do so.

Respectfully submitted,

Date: 21 Dec. 01

By: _____
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BOS2_185485.1

Appendix showing details of the Amendment

Claims 1-10 are cancelled.

11. A shank-end tool for the milling-type machining of chipless materials for the manufacture of molds, especially heat-resistant casting molds for producing metal castings, said tool comprising:

a shank portion having a longitudinal axis, a first end that can be connected detachably to a drive device and a second end with a groove-shaped recess extending in the longitudinal direction; and

a cutter blade in said groove and fixedly attached to the shank, said cutter blade having a flat leading face in a direction of advance during use,

wherein the cutter blade is provided with a wear resistant blade edge on the leading face.

12. A shank-end tool in accord with Claim 11, wherein the cutter blade is a flat blank of a material selected from the group consisting of steel, wear-resistant steel, or a wear-resistant material, and wherein said blade edge is at a right angle to the flat leading face.

13. A shank-end tool in accord with Claim 11, cutter blade further comprising a trailing edge behind the blade edge when viewed in the direction of advance, wherein the blade edge and the trailing edge are rounded.

14. A shank-end tool in accord with Claim 11, wherein the flat leading face of the cutter blade has a rounded corner or a corner cut at an angle.

15. A shank-end tool in accord with Claim 11, wherein the flat leading face of the cutter blade has an outer contour with a circular arc or conical shape.

16. A shank-end tool in accord with Claim 11, the cutter blade further comprises a curved surface having a convex face or a bent surface, parallel to the longitudinal axis, with the convex face of the curved surface or of the bend pointing in a direction of rotation of the shank in use.

17. A shank-end tool in accord with Claim 11, wherein the cutter blade further comprises shovel-like blade folds that are sloped with a blade angle relative to the longitudinal axis to produce fan-like action.

18. A shank-end tool in accord with Claim 11, wherein the cutter blade comprises a material selected from the group consisting of a metal, a high-strength elastically deformable material, and a springy material.

19. A shank-end tool in accord with Claim 11, wherein the cutter blade comprises a steel base material and is provided with a wear-protective covering on the leading flat face, the wear-protective covering being a material selected from the group consisting of a hard substance, a metal composite containing hard substances. and a metal alloy containing a hard substance.

20. A shank-end tool in accord with Claim 11, wherein the shank comprises a tubular or cylindrical hollow body at least at the second end.

21. A method for the milling-type machining of chipless materials for the manufacture of heat-resistant molds, said method comprising:

providing a shank-end tool comprising:

a shank portion having a longitudinal axis, a first end that can be connected detachably to a drive device and a second end with a groove-shaped recess extending in the longitudinal direction; and

a cutter blade in said groove and fixedly attached to the shank, said cutter blade having a flat leading face in a direction of advance during use,

wherein the cutter blade is provided with a wear resistant blade edge on the leading face:

machining a chipless material with the shank-end tool to provide a finished form.

22. A method for the milling-type machining of chipless materials in accord with claim 21, wherein the cutter blade is a flat blank of a material selected from the group consisting of steel, wear-resistant steel, or a wear-resistant material, and wherein said blade edge is at a right angle to the flat leading face.

23. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade further comprises a trailing edge behind the blade edge when viewed in the direction of advance, wherein the blade edge and the trailing edge are rounded.

24. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the flat leading face of the cutter blade has a rounded corner or a corner cut at an angle.

25. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the flat leading face of the cutter blade has an outer contour with a circular arc or conical shape.

26. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade further comprises a curved surface having a convex face or a bent surface, parallel to the longitudinal axis, with the convex face of the curved surface or of the bend pointing in a direction of rotation of the shank in use.

27. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade further comprises shovel-like blade folds that are sloped with a blade angle relative to the longitudinal axis to produce fan-like action.

28. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade comprises a material selected from the group consisting of a metal, a high-strength elastically deformable material, and a springy material.

29. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the cutter blade comprises a steel base material and is provided with a wear-protective covering on the leading flat face, the wear-protective covering being a material selected from the group consisting of a hard substance, a metal composite containing hard substances. and a metal alloy containing a hard substance.

30. A method for the milling-type machining of chipless materials in accord with Claim 21, wherein the shank comprises a tubular or cylindrical hollow body at least at the second end.

Attorney Docket No. 71980/56667

Substitute Specification

SHANK-END TOOL WITH PERMANENTLY ATTACHED WING-LIKE INSERTS

Background of the Invention

This invention relates to a shank-end tool with permanently attached wing-like inserts for the milling-type machining of chipless materials for the manufacture of molds, especially heat-resistant casting molds for producing metal castings.

Primarily sand molds that are made with the help of patterns are used in practice to produce metal castings. Since it is costly to make patterns, there has long been a need to make casting molds by direct machining of heat-resistant molding compositions for small and medium-sized runs.

In DE PS 26 05 687 C3, a cutting and milling tool is used to hollow out a mold cavity to produce sand molds, which is used in active combination with a duplicating miller. The milling tool has a knife assembly with a cutter that conforms essentially to an inverted T-shape and is fastened to an arm that rotates around an axis of rotation. The cutter is interchangeable, it is curved on the outside to smooth the mold surface according to the inside diameter of the casting mold to be produced, and viewed in the direction of rotation it is shaped on the forward edge so that a cutting edge is formed. A hardenable green sand with low strength of 2-5 kg/cm^2 compacted in a molding box is hollowed out with the cutter before the final strength of the molding sand after hardening is reached. This is to prevent fast wear of the cutting edge. The method is relatively difficult to perform because the proper time for the machining has to be provided for during the hardening of the mold. Otherwise the mold becomes dirty with low-strength molding sand, or the cutter quickly becomes unusable with high-strength sand. Furthermore, the milling tools can be used only to make rotationally symmetrical parts.

On the other hand, it was proposed in DD 275 419 A1 to work out a casting mold from a single block of mold material with tools that have no cutter geometry. To produce a cavity in a block of

mold material, a device is used that includes a rod-shaped driver driven around an axis on which at least two non-rigid or semi-rigid carriers variable in length are guided. Active machining units are fastened to these carriers and are positioned at identical angular graduations on the driver to avoid imbalance. Flat parts such as triangular plates, stars, or the like, or balls or squares or others with or without edges can be used as active machining units, for example. Cables, wire cables, sheet metal strips, chains, or the like can be used as non-rigid or semi-rigid carriers, and are provided with additional guard elements to protect against the wear caused by the eroded sand mold material.

To increase excavating capacity, it is necessary during the machining to achieve the highest possible stiffness of the carriers by arranging the machining units to be movable and having them braced against one another. The device can be run under computer control on the arm of a robot. In the same way, it is also possible to control the device by a CNC machine. To improve the surface of the castings, the inner surfaces enclosing the cavity space are sprayed in a concluding step with a smoothing agent, which has to be distributed evenly over the surface. In this case also, it is a drawback that essentially only molds that differ only roughly from rotationally symmetrical parts can be made. The low surface quality of the castings produced with the casting molds is a drawback that can be attributed to the more or less beating action of the tools.

Shank-end millers that have a circular contour are customary for the production of casting molds. The shank-end miller described in DE 197 21 900 A1 has a cutting plate on the free end that is fastened to the shank with tightening screws. The shank has a plate seat with a threaded bore, with the cutting plate being provided with a drilled hole. However, such fastening runs into problems when the dimensions of the cutting plates are smaller than a minimum size. Therefore, it is difficult to loosen the cutting plate or to fasten it satisfactorily. It is also a drawback that the cutting plate is exposed to high wear from chipless materials. This makes it necessary to change tools constantly, which is associated with correspondingly high cost.

To reduce the tool cost occurring from high wear, an economically manufactured milling tool was proposed in DE 3914074 A1 that has a cylindrical shank and a flat cutter support. The cutter support is provided with cutting edges at its edges farthest from the axis of the shank. There are additional frontal cutting plates on the face of the cutter support. The shank is designed as a borer

at one end so that the miller can function as a face mill. The cutters are positioned at the radially terminal outer edges of the cutter support relative to the axis of the shank. The cross section of the milling tool shows an S-shaped profile with the cutting edge pointing in the cutting direction. For this reason the previously described miller can be used only for chip-forming materials. Use is not possible for chipless materials.

Foundry sands containing binders bring about a severe degree of wear of the tool cutters, which is caused by wear of the cutters at the cutting edges and frictional wear on the open surfaces. For this reason there is cutting action only with new tools, and there is thus a time limit for it. The cutter wear is manifested as rounding of the forward edge of the tool, which causes additional frictional wear in the area behind the cutting edge. This frictional wear increasingly erodes the outer surfaces and deforms the tool increasingly toward the rear opposite to the direction of rotation. The energy corresponding to the friction is converted into heat, which can lead to heating of the tool and to more rapidly increasing wear.

The problem underlying this invention is to design a shank-end tool for milling-type machining that is simple and economical to manufacture, in such a way that it remains functional with unavoidable frictional wear and with increasing erosion. The machining action should be retained for a lengthy period of time. The losses from friction should be lowered.

Summary of the Invention

The problem is solved pursuant to the invention with a shank-end tool with a wing-like cutter blade as a cutter insert that is characterized by a shank (1) rotatable around its longitudinal axis (2) that can be connected detachably to a drive device and is provided at its free end section (6) with at least one groove-shaped recess (7) extending in the axial direction and one flat cutter blade (8), which is provided with a wear resistant cutting blade edge (12) on its leading face viewed in the direction of advance (9). The minimal blade thickness brings about a substantial reduction of friction between the blade edges and the casting mold surface, which not only reduces the erosion of the cutter blade but also increases the working life of the tool. Because of this the tool is particularly suitable for high-speed machining, since it has reduced weight and the cooling of the blade edges is increased at high speeds of rotation.

The proposed shank-end tool is composed of easily made semifinished parts, and it can be made economically in this way, which will be described in detail below with reference to an example of embodiment. Other benefits and refinements of the invention are shown in the following description. Examples of such other benefits and refinements include preferred shank-end tools characterized by the fact that the cutter blade (8) is made as a part punched out of a flat blank made of steel, wear-resistant steel, or a suitable wear-resistant material, and is provided with a blade edge (12) at a right angle to the flat face (11); characterized by the fact that the blade edge (12) and the trailing edge (13) of the cutter blade (8) behind the blade edge (12) viewed in the direction of advance (9) are given a radius or are rounded; characterized by the fact that the cutter blade (8) has the basic form of a square or rectangular blank, and/or is provided on the face with rounding (17) or corners (18) cut at an angle; characterized by the fact that the cutter blade (8) is provided with a circular arc-shaped or conical outer contour; characterized by the fact that the cutter blade (8) is provided with curvature (22) or bending (23) parallel to the longitudinal axis (2), with the convex face of the curvature (22) or of the bend (23) pointing in the direction of rotation (24); characterized by the fact that the cutter blade (8) has shovel-like blade folds (25) that are sloped with a blade angle (26) relative to the longitudinal axis (2), to produce fan-like action; characterized by the fact that the cutter blade (8) is made of a metallic blade material, a high-strength elastically deformable blade material, or a springy blade material; characterized by the fact that the cutter blade (8) has a steel base material and is provided with a wear-protective covering (15) on its leading flat face (11) consisting of a hard substance or a metal composite containing hard substances or a metal alloy containing a hard substance; or characterized by the fact that the shank (1) has a tubular or cylindrical hollow body (5) at least in the area of the cutter blade holder (4).

Brief Description of the Drawings

The attached drawings show:

Figure 1 a shank-end tool with a rectangular cutter blade,

Figure 2 a shank-end tool with a cutter blade with arc-shaped blade edge,

Figure 3 a shank-end tool with a cutter blade with rounded blade edges,

Figure 4 a shank-end tool with a cutter blade with angled blade edges,

Figure 5 a shank-end tool with a cutter blade with conical blade edges,

Figure 6 a shank-end tool with a tubular shank,

Figure 7 a shank-end tool with cutter blades positioned with double symmetry,

Figure 8 a shank-end tool with a curved cutter blade convex in the direction of rotation,

Figure 9 a shank-end tool with angled-back cutter blade convex in the direction of rotation,

Figure 10 a shank-end tool with angled-back cutter blade convex in the direction of rotation with obliquely pitched blade edges

in schematic illustration.

Detailed Description of the Invention Including Preferred Embodiments

The shank-end tool shown in Figure 1 for the milling-type machining of chipless materials, which may include coarse-crystalline sand particularly in the manufacture of heat-resistant casting molds for metal castings, consists essentially of two simple parts that are assembled in a suitable way, for example by interlocking assembly, welding, soldering, or cementing.

The elongated and cylindrical shank 1 rotatable around its longitudinal axis 2 has an upper shank section 3 that can be connected detachably to a tool holder for rotary cutting tools. According to Figure 6, the shank 1 is of tubular design with a hollow body 5. A tubular hollow body 5 offers a substantial saving of weight, which becomes a particularly noticeable advantage especially at high speeds of rotation. Another benefit may consist of the fact that the shank 1, at least in the

area of the cutter blade mount 4, is designed as a tubular hollow body 5. In this way the hollow body 5 can be lengthened with a fitted cylindrical shank section 3 when machining deep parts.

The shank 1 at its free end section 6 is provided with a groove-shaped recess 7 in the area of the cutter blade mount 4, extending in the axial direction, to hold the cutter blade 8. According to Figure 7, by way of example, there are two groove-shaped recesses 7 so that two cutter blades 8 can be positioned with double symmetry. In the case of a tubular hollow body 5, the cutter blades 8 can be interlaced with one another by two opposite half cutaways in the longitudinal axis 2, and can be fastened in the recess 7 in an especially simple way, for example by soldering. This guarantees a secure mount at high speeds of rotation.

The cutter blade 8 can be produced as a punched part by punching from a flat blank of sheet metal or wear-resistant sheet metal, with the invention not being limited to the mentioned examples of embodiment. Instead, unmentioned suitable materials and semifinished products can also be used, if they are within the scope of the patent claims. In particular, this is true for composite materials, fiber composition materials, or high-strength materials or ceramic or fiber-composite ceramic elements.

The cutter blade 8 according to Figure 1 is provided with a wear resistant cutting blade edge 12 on the leading flat side 11 viewed in the direction of advance 9, at a right angle to the flat side 11 when a simple punched part is used. In this case the blade thickness can be comparatively small.

The blade thickness can be 0.1 mm - 5.00 mm. The blade thickness is preferably 0.2 - 1.00 mm.

In particular, the blade thickness should be no greater so that the tangential angle of the flank of the leading blade edge 12 is close to or equal to zero.

When high-strength or composite materials are used, the blade edge 12 and the trailing edge 13 behind the blade edge 12 of the cutter blade 8 viewed in the direction of advance 9 are given a radius or are rounded. Frictional heat and wear are reduced by a small tangential angle and by rounding.

Additional reduction of friction in the area of the trailing edge 13 can be achieved with a cutter blade 8 that has a base material of steel and is joined to a high-strength wear-protective covering 15 on the leading flat face 11. Any hard substance or metal composites containing a hard substance, or a metal alloy or composite material containing a hard substance can be provided as the wear-protective covering 15. Wear of the blade edge 12 becomes lower because of the wear-protective covering 15 applied to the leading flat face 11. The trailing edge 13 on the cutter blade 8 made of steel erodes more severely because of its low strength, so that the flank that has low frictional resistance becomes rounded.

The cutter blade 8 can have diverse forms. Thus different shank-end tools can be used in succession when machining casting molds using CNC-controlled machine tools with automatic tool change, so that the production of complicated molds can be substantially simplified. In the basic form, the cutter blade 8 of Figure 1 and Figures 3-10 has a square or rectangular blank. In Figure 3 the cutter blade 8 is rounded 17 on its face 16, or in Figure 4 it is provided with corners 18 cut off at an angle on the face.

The cutter blade 8 of Figure 2 has an outer contour that has the shape of a circular arc 19, and in Figure 5 a trapezoidal contour 21 can be seen, which produces a cone when rotated around the longitudinal axis 2 of the shank-end tool.

In a particularly beneficial refinement of the shank-end tool, the cutter blade 8 can have convex curvature 22 parallel to the longitudinal axis 2 according to Figure 8, or in Figure 9 it can have convex folding 23 in the direction of rotation 24. If the cutter blade 8 is made of an elastically deformable or springy blade material of low thickness, the curvature 22 can be reduced at higher speeds, as in the case of high-speed machining. In this way the tool radius can be kept constant with increasing wear of the cutter blade 8 because of a speed increase. Metal cutter blades 8 that have high wear resistance are especially suitable for this process. Filigree casting molds that have a very smooth mold surface can be manufactured with the shank-end tools shown, using foundry sand.

To eliminate the machining residues formed during the cutting of the material, it is advantageous for the cutter blade 8 to have shovel-like blade bends 25 according to Figure 10 to produce fan-

like action, by providing a blade angle 26 relative to the longitudinal axis 2. The eroded material residues can thus be carried away from the point of machining primarily in the axial direction.

Abstract of the Disclosure

Shank-end tool with permanently attached wing-like inserts

A shank-end tool is described that is simple and economical to manufacture, with permanently attached wing-like inserts for the milling-type machining of chipless materials that remains functional with unavoidable frictional wear and with increasing erosion. The shank-end tool is characterized by a shank (1) rotatable around its longitudinal axis (2) that can be connected detachably to a drive device and is provided at its free end section (6) with at least one groove-shaped recess (7) extending in the axial direction and one flat cutter blade (8), which is provided with a non-cutting blade edge (12) on its leading face viewed in the direction of advance (9). The shank-end tool is used for the manufacture of molds, especially heat-resistant casting molds for the production of metal castings.

Substitute Specification

SHANK-END TOOL WITH PERMANENTLY ATTACHED WING-LIKE INSERTS

Background of the Invention ~~*Shank-end tool with permanently attached wing-like inserts*~~

This invention relates to a shank-end tool with permanently attached wing-like inserts for the milling-type machining of chipless materials for the manufacture of molds, especially heat-resistant casting molds for producing metal castings.

Primarily sand molds that are made with the help of patterns are used in practice to produce metal castings. Since it is costly to make patterns, there has long been a need to make casting molds by direct machining of heat-resistant molding compositions for small and medium-sized runs.

In DE PS 26 05 687 C3, a cutting and milling tool is used to hollow out a mold cavity to produce sand molds, which is used in active combination with a duplicating miller. The milling tool has a knife assembly with a cutter that conforms essentially to an inverted T-shape and is fastened to an arm that rotates around an axis of rotation. The cutter is interchangeable, it is curved on the outside to smooth the mold surface according to the inside diameter of the casting mold to be produced, and viewed in the direction of rotation it is shaped on the forward edge so that a cutting edge is formed. A hardenable green sand with low strength of 2-5 kg/cm^2 compacted in a molding box is hollowed out with the cutter before the final strength of the molding sand after hardening is reached. This is to prevent fast wear of the cutting edge. The method is relatively difficult to perform because the proper time for the machining has to be provided for during the hardening of the mold. Otherwise the mold becomes dirty with low-strength molding sand, or the cutter quickly becomes unusable with high-strength sand. Furthermore, the milling tools can be used only to make rotationally symmetrical parts.

On the other hand, it was proposed in DD 275 419 A1 to work out a casting mold from a single block of mold material with tools that have no cutter geometry. To produce a cavity in a block of mold material, a device is used that includes a rod-shaped driver driven around an axis on which at least two non-rigid or semi-rigid carriers variable in length are guided. Active machining units are fastened to these carriers and are positioned at identical angular graduations on the driver to avoid imbalance. Flat parts such as triangular plates, stars, or the like, or balls or squares or others with or without edges can be used as active machining units, for example. Cables, wire cables, sheet metal strips, chains, or the like can be used as non-rigid or semi-rigid carriers, and are provided with additional guard elements to protect against the wear caused by the eroded sand mold material.

To increase excavating capacity, it is necessary during the machining to achieve the highest possible stiffness of the carriers by arranging the machining units to be movable and having them braced against one another. The device can be run under computer control on the arm of a robot. In the same way, it is also possible to control the device by a

CNC machine. To improve the surface of the castings, the inner surfaces enclosing the cavity space are sprayed in a concluding step with a smoothing agent, which has to be distributed evenly over the surface. In this case also, it is a drawback that essentially only molds that differ only roughly from rotationally symmetrical parts can be made. The low surface quality of the castings produced with the casting molds is a drawback that can be attributed to the more or less beating action of the tools.

Shank-end millers that have a circular contour are customary for the production of casting molds. The shank-end miller described in DE 197 21 900 A1 has a cutting plate on the free end that is fastened to the shank with tightening screws. The shank has a plate seat with a threaded bore, with the cutting plate being provided with a drilled hole. However, such fastening runs into problems when the dimensions of the cutting plates are smaller than a minimum size. Therefore, it is difficult to loosen the cutting plate or to fasten it satisfactorily. It is also a drawback that the cutting plate is exposed to high wear from chipless materials. This makes it necessary to change tools constantly, which is associated with correspondingly high cost.

To reduce the tool cost occurring from high wear, an economically manufactured milling tool was proposed in DE 3914074 A1 that has a cylindrical shank and a flat cutter support. The cutter support is provided with cutting edges at its edges farthest from the axis of the shank. There are additional frontal cutting plates on the face of the cutter support. The shank is designed as a borer at one end so that the miller can function as a face mill. The cutters are positioned at the radially terminal outer edges of the cutter support relative to the axis of the shank. The cross section of the milling tool shows an S-shaped profile with the cutting edge pointing in the cutting direction. For this reason the previously described miller can be used only for chip-forming materials. Use is not possible for chipless materials.

Foundry sands containing binders bring about a severe degree of wear of the tool cutters, which is caused by wear of the cutters at the cutting edges and frictional wear on the open surfaces. For this reason there is cutting action only with new tools, and there is thus a time limit for it. The cutter wear is manifested as rounding of the forward edge of the tool, which causes additional frictional wear in the area behind the cutting edge. This frictional wear increasingly erodes the outer surfaces and deforms the tool increasingly toward the rear opposite to the direction of rotation. The energy corresponding to the friction is converted into heat, which can lead to heating of the tool and to more rapidly increasing wear.

The problem underlying this invention is to design a shank-end tool for milling-type machining that is simple and economical to manufacture, in such a way that it remains functional with unavoidable frictional wear and with increasing erosion. The machining action should be retained for a lengthy period of time. The losses from friction should be lowered.

Summary of the Invention

The problem is solved pursuant to the invention with a shank-end tool with a wing-like cutter blade as a cutter insert that ~~has the features mentioned in the characterizing part of Patent Claim 1~~ is characterized by a shank (1) rotatable

around its longitudinal axis (2) that can be connected detachably to a drive device and is provided at its free end section (6) with at least one groove-shaped recess (7) extending in the axial direction and one flat cutter blade (8), which is provided with a wear resistant cutting blade edge (12) on its leading face viewed in the direction of advance (9). The minimal blade thickness brings about a substantial reduction of friction between the blade edges and the casting mold surface, which not only reduces the erosion of the cutter blade but also increases the working life of the tool. Because of this the tool is particularly suitable for high-speed machining, since it has reduced weight and the cooling of the blade edges is increased at high speeds of rotation.

The proposed shank-end tool is composed of easily made semifinished parts, and it can be made economically in this way, which will be described in detail below with reference to an example of embodiment. Other benefits and refinements of the invention are shown in the following description ~~and in the subclaims.~~. Examples of such other benefits and refinements include preferred shank-end tools characterized by the fact that the cutter blade (8) is made as a part punched out of a flat blank made of steel, wear-resistant steel, or a suitable wear-resistant material, and is provided with a blade edge (12) at a right angle to the flat face (11); characterized by the fact that the blade edge (12) and the trailing edge (13) of the cutter blade (8) behind the blade edge (12) viewed in the direction of advance (9) are given a radius or are rounded; characterized by the fact that the cutter blade (8) has the basic form of a square or rectangular blank, and/or is provided on the face with rounding (17) or corners (18) cut at an angle; characterized by the fact that the cutter blade (8) is provided with a circular arc-shaped or conical outer contour; characterized by the fact that the cutter blade (8) is provided with curvature (22) or bending (23) parallel to the longitudinal axis (2), with the convex face of the curvature (22) or of the bend (23) pointing in the direction of rotation (24); characterized by the fact that the cutter blade (8) has shovel-like blade folds (25) that are sloped with a blade angle (26) relative to the longitudinal axis (2), to produce fan-like action; characterized by the fact that the cutter blade (8) is made of a metallic blade material, a high-strength elastically deformable blade material, or a springy blade material; characterized by the fact that the cutter blade (8) has a steel base material and is provided with a wear-protective covering (15) on its leading flat face (11) consisting of a hard substance or a metal composite containing hard substances or a metal alloy containing a hard substance; or characterized by the fact that the shank (1) has a tubular or cylindrical hollow body (5) at least in the area of the cutter blade holder (4).

Brief Description of the Drawings

The attached drawings show:

Figure 1 a shank-end tool with a rectangular cutter blade,

Figure 2 a shank-end tool with a cutter blade with arc-shaped blade edge,

Figure 3 a shank-end tool with a cutter blade with rounded blade edges,

Figure 4 a shank-end tool with a cutter blade with angled blade edges,

Figure 5 a shank-end tool with a cutter blade with conical blade edges,

Figure 6 a shank-end tool with a tubular shank,

Figure 7 a shank-end tool with cutter blades positioned with double symmetry,

Figure 8 a shank-end tool with a curved cutter blade convex in the direction of rotation,

Figure 9 a shank-end tool with angled-back cutter blade convex in the direction of rotation,

Figure 10 a shank-end tool with angled-back cutter blade convex in the direction of rotation with obliquely pitched blade edges

in schematic illustration.

Detailed Description of the Invention Including Preferred Embodiments

The shank-end tool shown in Figure 1 for the milling-type machining of chipless materials, which may include coarse-crystalline sand particularly in the manufacture of heat-resistant casting molds for metal castings, consists essentially of two simple parts that are assembled in a suitable way, for example by interlocking assembly, welding, soldering, or cementing.

The elongated and cylindrical shank 1 rotatable around its longitudinal axis 2 has an upper shank section 3 that can be connected detachably to a tool holder for rotary cutting tools. According to Figure 6, the shank 1 is of tubular design with a hollow body 5. A tubular hollow body 5 offers a substantial saving of weight, which becomes a particularly noticeable advantage especially at high speeds of rotation. Another benefit may consist of the fact that the shank 1, at least in the area of the cutter blade mount 4, is designed as a tubular hollow body 5. In this way the hollow body 5 can be lengthened with a fitted cylindrical shank section 3 when machining deep parts.

The shank 1 at its free end section 6 is provided with a groove-shaped recess 7 in the area of the cutter blade mount 4, extending in the axial direction, to hold the cutter blade 8. According to Figure 7, by way of example, there are two groove-shaped recesses 7 so that two cutter blades 8 can be positioned with double symmetry. In the case of a tubular hollow body 5, the cutter blades 8 can be interlaced with one another by two opposite half cutaways in the longitudinal axis 2, and can be fastened in the recess 7 in an especially simple way, for example by soldering. This guarantees a secure mount at high speeds of rotation.

The cutter blade 8 can be produced as a punched part by punching from a flat blank of sheet metal or wear-resistant sheet metal, with the invention not being limited to the mentioned examples of embodiment. Instead, unmentioned

suitable materials and semifinished products can also be used, if they are within the scope of the patent claims. In particular, this is true for composite materials, fiber composition materials, or high-strength materials or ceramic or fiber-composite ceramic elements.

The cutter blade 8 according to Figure 1 is provided with a ~~non-~~wear resistant cutting blade edge 12 on the leading flat side 11 viewed in the direction of advance 9, at a right angle to the flat side 11 when a simple punched part is used. In this case the blade thickness can be comparatively small.

The blade thickness can be 0.1 mm - 5.00 mm. The blade thickness is preferably 0.2 - 1.00 mm.

In particular, the blade thickness should be no greater so that the tangential angle of the flank of the leading blade edge 12 is close to or equal to zero.

When high-strength or composite materials are used, the blade edge 12 and the trailing edge 13 behind the blade edge 12 of the cutter blade 8 viewed in the direction of advance 9 are given a radius or are rounded. Frictional heat and wear are reduced by a small tangential angle and by rounding.

Additional reduction of friction in the area of the trailing edge 13 can be achieved with a cutter blade 8 that has a base material of steel and is joined to a high-strength wear-protective covering 15 on the leading flat face 11. Any hard substance or metal composites containing a hard substance, or a metal alloy or composite material containing a hard substance can be provided as the wear-protective covering 15. Wear of the blade edge 12 becomes lower because of the wear-protective covering 15 applied to the leading flat face 11. The trailing edge 13 on the cutter blade 8 made of steel erodes more severely because of its low strength, so that the flank that has low frictional resistance becomes rounded.

The cutter blade 8 can have diverse forms. Thus different shank-end tools can be used in succession when machining casting molds using CNC-controlled machine tools with automatic tool change, so that the production of complicated molds can be substantially simplified. In the basic form, the cutter blade 8 of Figure 1 and Figures 3-10 has a square or rectangular blank. In Figure 3 the cutter blade 8 is rounded 17 on its face 16, or in Figure 4 it is provided with corners 18 cut off at an angle on the face.

The cutter blade 8 of Figure 2 has an outer contour that has the shape of a circular arc 19, and in Figure 5 a trapezoidal contour 21 can be seen, which produces a cone when rotated around the longitudinal axis 2 of the shank-end tool.

In a particularly beneficial refinement of the shank-end tool, the cutter blade 8 can have convex curvature 22 parallel to the longitudinal axis 2 according to Figure 8, or in Figure 9 it can have convex folding 23 in the direction of rotation 24. If the cutter blade 8 is made of an elastically deformable or springy blade material of low thickness, the curvature 22 can be reduced at higher speeds, as in the case of high-speed machining. In this way the tool radius can

be kept constant with increasing wear of the cutter blade 8 because of a speed increase. Metal cutter blades 8 that have high wear resistance are especially suitable for this process. Filigree casting molds that have a very smooth mold surface can be manufactured with the shank-end tools shown, using foundry sand.

To eliminate the machining residues formed during the cutting of the material, it is advantageous for the cutter blade 8 to have shovel-like blade bends 25 according to Figure 10 to produce fan-like action, by providing a blade angle 26 relative to the longitudinal axis 2. The eroded material residues can thus be carried away from the point of machining primarily in the axial direction.

~~Abstract~~

Abstract of the Disclosure

Shank-end tool with permanently attached wing-like inserts

~~This invention relates to a~~

A shank-end tool is described that is simple and economical to manufacture, with permanently attached wing-like inserts for the milling-type machining of chipless materials that remains functional with unavoidable frictional wear and with increasing erosion. ~~According to the invention, the~~ The shank-end tool is characterized by a shank (1) rotatable around its longitudinal axis (2) that can be connected detachably to a drive device and is provided at its free end section (6) with at least one groove-shaped recess (7) extending in the axial direction and one flat cutter blade (8), which is provided with a non-cutting blade edge (12) on its leading face viewed in the direction of advance (9). The shank-end tool is used for the manufacture of molds, especially heat-resistant casting molds for the production of metal castings.

~~The shank-end tool is used for the manufacture of molds, especially heat-resistant casting molds for the production of metal castings.~~

~~FIG. 1~~

~~8. Shank-end tool pursuant to one of the Patent Claims 1 to 7, characterized by the fact that the cutter blade (8) is made of a metallic blade material, a high-strength elastically deformable blade material, or a springy blade material.~~

~~9. Shank-end tool pursuant to one or more of the Patent Claims 1 to 8, characterized by the fact that the cutter blade (8) has a steel base material and is provided with a wear-protective covering (15) on its leading flat face (11) consisting of a hard substance or a metal composite containing hard substances or a metal alloy containing a hard substance.~~

~~10. Shank-end tool pursuant to one or more of the Patent Claims 1 to 9, characterized by the fact that the shank (1) has a tubular or cylindrical hollow body (5) at least in the area of the cutter blade holder (4).~~

Shank-end tool with permanently attached wing-like inserts

This invention relates to a shank-end tool with permanently attached wing-like inserts for the milling-type machining of chipless materials for the manufacture of molds, especially heat-resistant casting molds for producing metal castings.

Primarily sand molds that are made with the help of patterns are used in practice to produce metal castings. Since it is costly to make patterns, there has long been a need to make casting molds by direct machining of heat-resistant molding compositions for small and medium-sized runs.

In DE PS 26 05 687 C3, a cutting and milling tool is used to hollow out a mold cavity to produce sand molds, which is used in active combination with a duplicating miller. The milling tool has a knife assembly with a cutter that conforms essentially to an inverted T-shape and is fastened to an arm that rotates around an axis of rotation. The cutter is interchangeable, it is curved on the outside to smooth the mold surface according to the inside diameter of the casting mold to be produced, and viewed in the direction of rotation it is shaped on the forward edge so that a cutting edge is formed. A hardenable green sand with low strength of 2-5 kg/cm^2 compacted in a molding box is hollowed out with the cutter before the final strength of the molding sand after hardening is reached. This is to prevent fast wear of the cutting edge. The method is relatively difficult to perform because the proper time for the machining has to be provided for during the hardening of the mold. Otherwise the mold becomes dirty with low-strength molding sand, or the cutter quickly becomes unusable with high-strength sand. Furthermore, the milling tools can be used only to make rotationally symmetrical parts.

On the other hand, it was proposed in DD 275 419 A1 to work out a casting mold from a single block of mold material with tools that have no cutter geometry. To produce a cavity in a block of mold material, a device is used that includes a rod-shaped driver driven around an axis on which at least two non-rigid or semi-rigid carriers variable in length are guided. Active machining units are fastened to these carriers and are positioned at identical angular graduations on the driver to avoid imbalance. Flat parts such as triangular plates, stars, or the like, or balls or squares or others with or without edges can be used as active machining units, for example. Cables, wire

cables, sheet metal strips, chains, or the like can be used as non-rigid or semi-rigid carriers, and are provided with additional guard elements to protect against the wear caused by the eroded sand mold material.

To increase excavating capacity, it is necessary during the machining to achieve the highest possible stiffness of the carriers by arranging the machining units to be movable and having them braced against one another. The device can be run under computer control on the arm of a robot. In the same way, it is also possible to control the device by a CNC machine. To improve the surface of the castings, the inner surfaces enclosing the cavity space are sprayed in a concluding step with a smoothing agent, which has to be distributed evenly over the surface. In this case also, it is a drawback that essentially only molds that differ only roughly from rotationally symmetrical parts can be made. The low surface quality of the castings produced with the casting molds is a drawback that can be attributed to the more or less beating action of the tools.

Shank-end millers that have a circular contour are customary for the production of casting molds. The shank-end miller described in DE 197 21 900 A1 has a cutting plate on the free end that is fastened to the shank with tightening screws. The shank has a plate seat with a threaded bore, with the cutting plate being provided with a drilled hole. However, such fastening runs into problems when the dimensions of the cutting plates are smaller than a minimum size. Therefore, it is difficult to loosen the cutting plate or to fasten it satisfactorily. It is also a drawback that the cutting plate is exposed to high wear from chipless materials. This makes it necessary to change tools constantly, which is associated with correspondingly high cost.

To reduce the tool cost occurring from high wear, an economically manufactured milling tool was proposed in DE 3914074 A1 that has a cylindrical shank and a flat cutter support. The cutter support is provided with cutting edges at its edges farthest from the axis of the shank. There are additional frontal cutting plates on the face of the cutter support. The shank is designed as a borer at one end so that the miller can function as a face mill. The cutters are positioned at the radially terminal outer edges of the cutter support relative to the axis of the shank. The cross section of the milling tool shows an S-shaped profile with the cutting edge pointing in the cutting direction. For this reason the previously described miller can be used only for chip-forming materials. Use is not possible for chipless materials.

Foundry sands containing binders bring about a severe degree of wear of the tool cutters, which is caused by wear of the cutters at the cutting edges and frictional wear on the open surfaces. For this reason there is cutting action only with new tools, and there is thus a time limit for it. The cutter wear is manifested as rounding of the forward edge of the tool, which causes additional frictional wear in the area behind the cutting edge. This frictional wear increasingly erodes the outer surfaces and deforms the tool increasingly toward the rear opposite to the direction of rotation. The energy corresponding to the friction is converted into heat, which can lead to heating of the tool and to more rapidly increasing wear.

The problem underlying this invention is to design a shank-end tool for milling-type machining that is simple and economical to manufacture, in such a way that it remains functional with unavoidable frictional wear and with increasing erosion. The machining action should be retained for a lengthy period of time. The losses from friction should be lowered.

The problem is solved pursuant to the invention with a shank-end tool with a wing-like cutter blade as a cutter insert that has the features mentioned in the characterizing part of Patent Claim 1. The minimal blade thickness brings about a substantial reduction of friction between the blade edges and the casting mold surface, which not only reduces the erosion of the cutter blade but also increases the working life of the tool. Because of this the tool is particularly suitable for high-speed machining, since it has reduced weight and the cooling of the blade edges is increased at high speeds of rotation.

The proposed shank-end tool is composed of easily made semifinished parts, and it can be made economically in this way, which will be described in detail below with reference to an example of embodiment. Other benefits and refinements of the invention are shown in the following description and in the subclaims.

The attached drawings show:

Figure 1 a shank-end tool with a rectangular cutter blade,

Figure 2 a shank-end tool with a cutter blade with arc-shaped blade edge,

Figure 3 a shank-end tool with a cutter blade with rounded blade edges,

Figure 4 a shank-end tool with a cutter blade with angled blade edges,

Figure 5 a shank-end tool with a cutter blade with conical blade edges,

Figure 6 a shank-end tool with a tubular shank,

Figure 7 a shank-end tool with cutter blades positioned with double symmetry,

Figure 8 a shank-end tool with a curved cutter blade convex in the direction of rotation,

Figure 9 a shank-end tool with angled-back cutter blade convex in the direction of rotation,

Figure 10 a shank-end tool with angled-back cutter blade convex in the direction of rotation with obliquely pitched blade edges

in schematic illustration.

The shank-end tool shown in Figure 1 for the milling-type machining of chipless materials, which may include coarse-crystalline sand particularly in the manufacture of heat-resistant casting molds for metal castings, consists essentially of two simple parts that are assembled in a suitable way, for example by interlocking assembly, welding, soldering, or cementing.

The elongated and cylindrical shank 1 rotatable around its longitudinal axis 2 has an upper shank section 3 that can be connected detachably to a tool holder for rotary cutting tools. According to Figure 6, the shank 1 is of tubular design with a hollow body 5. A tubular hollow body 5 offers a substantial saving of weight, which becomes a particularly noticeable advantage especially at high speeds of rotation. Another benefit may consist of the fact that the shank 1, at least in the

area of the cutter blade mount 4, is designed as a tubular hollow body 5. In this way the hollow body 5 can be lengthened with a fitted cylindrical shank section 3 when machining deep parts.

The shank 1 at its free end section 6 is provided with a groove-shaped recess 7 in the area of the cutter blade mount 4, extending in the axial direction, to hold the cutter blade 8. According to Figure 7, by way of example, there are two groove-shaped recesses 7 so that two cutter blades 8 can be positioned with double symmetry. In the case of a tubular hollow body 5, the cutter blades 8 can be interlaced with one another by two opposite half cutaways in the longitudinal axis 2, and can be fastened in the recess 7 in an especially simple way, for example by soldering. This guarantees a secure mount at high speeds of rotation.

The cutter blade 8 can be produced as a punched part by punching from a flat blank of sheet metal or wear-resistant sheet metal, with the invention not being limited to the mentioned examples of embodiment. Instead, unmentioned suitable materials and semifinished products can also be used, if they are within the scope of the patent claims. In particular, this is true for composite materials, fiber composition materials, or high-strength materials or ceramic or fiber-composite ceramic elements.

The cutter blade 8 according to Figure 1 is provided with a non-cutting blade edge 12 on the leading flat side 11 viewed in the direction of advance 9, at a right angle to the flat side 11 when a simple punched part is used. In this case the blade thickness can be comparatively small.

The blade thickness can be 0.1 mm - 5.00 mm. The blade thickness is preferably 0.2 - 1.00 mm.

In particular, the blade thickness should be no greater so that the tangential angle of the flank of the leading blade edge 12 is close to or equal to zero.

When high-strength or composite materials are used, the blade edge 12 and the trailing edge 13 behind the blade edge 12 of the cutter blade 8 viewed in the direction of advance 9 are given a radius or are rounded. Frictional heat and wear are reduced by a small tangential angle and by rounding.

Additional reduction of friction in the area of the trailing edge 13 can be achieved with a cutter blade 8 that has a base material of steel and is joined to a high-strength wear-protective covering 15 on the leading flat face 11. Any hard substance or metal composites containing a hard substance, or a metal alloy or composite material containing a hard substance can be provided as the wear-protective covering 15. Wear of the blade edge 12 becomes lower because of the wear-protective covering 15 applied to the leading flat face 11. The trailing edge 13 on the cutter blade 8 made of steel erodes more severely because of its low strength, so that the flank that has low frictional resistance becomes rounded.

The cutter blade 8 can have diverse forms. Thus different shank-end tools can be used in succession when machining casting molds using CNC-controlled machine tools with automatic tool change, so that the production of complicated molds can be substantially simplified. In the basic form, the cutter blade 8 of Figure 1 and Figures 3-10 has a square or rectangular blank. In Figure 3 the cutter blade 8 is rounded 17 on its face 16, or in Figure 4 it is provided with corners 18 cut off at an angle on the face.

The cutter blade 8 of Figure 2 has an outer contour that has the shape of a circular arc 19, and in Figure 5 a trapezoidal contour 21 can be seen, which produces a cone when rotated around the longitudinal axis 2 of the shank-end tool.

In a particularly beneficial refinement of the shank-end tool, the cutter blade 8 can have convex curvature 22 parallel to the longitudinal axis 2 according to Figure 8, or in Figure 9 it can have convex folding 23 in the direction of rotation 24. If the cutter blade 8 is made of an elastically deformable or springy blade material of low thickness, the curvature 22 can be reduced at higher speeds, as in the case of high-speed machining. In this way the tool radius can be kept constant with increasing wear of the cutter blade 8 because of a speed increase. Metal cutter blades 8 that have high wear resistance are especially suitable for this process. Filigree casting molds that have a very smooth mold surface can be manufactured with the shank-end tools shown, using foundry sand.

To eliminate the machining residues formed during the cutting of the material, it is advantageous for the cutter blade 8 to have shovel-like blade bends 25 according to Figure 10 to produce fan-

like action, by providing a blade angle 26 relative to the longitudinal axis 2. The eroded material residues can thus be carried away from the point of machining primarily in the axial direction.

Patent Claims

1. Use of a shank-end tool with permanently attached wing-like inserts for the milling-type machining of chipless materials for the manufacture of heat-resistant molds, especially sand molds containing binders for producing metal castings, characterized by a shank (1) rotatable around its longitudinal axis (2) that can be connected detachably to a drive device and is provided at its free end section (6) with at least one groove-shaped recess (7) extending in the axial direction and one flat cutter blade (8), which is provided with a non-cutting blade edge (12) on its leading face viewed in the direction of advance (9).

2. Use pursuant to Patent Claim 1, characterized by the fact that the cutter blade (8) is made as a part punched out of a flat blank made of steel, wear-resistant steel, or a suitable wear-resistant material, and is provided with an outer blade surface at a right angle to the flat face (11).

3. Use pursuant to one of the Patent Claims 1 to 2, characterized by the fact that the blade edge (12) and the trailing edge (13) of the cutter blade (8) behind the blade edge (12) viewed in the direction of advance (9) are given a radius or are rounded.

4. Use pursuant to one of the Patent Claims 1 to 3, characterized by the fact that the cutter blade (8) has the basic form of a square or rectangular blank, and/or is provided on the face with rounding (17) or corners (18) cut at an angle.

5. Use pursuant to one of the Patent Claims 1 to 3, characterized by the fact that the cutter blade (8) is provided with a circular arc-shaped or conical outer contour.

6. Use pursuant to one of the Patent Claims 1 to 5, characterized by the fact that the cutter blade (8) is provided with curvature (22) or bending (23) parallel to the longitudinal axis (2), with the convex face of the curvature (22) or of the bend (23) pointing in the direction of rotation (24).

7. Use pursuant to one of the Patent Claims 1 to 6, characterized by the fact that the cutter blade (8) has shovel-like blade folds (25) that are sloped with a blade angle (26) relative to the longitudinal axis (2), to produce fan-like action.

8. Use pursuant to one of the Patent Claims 1 to 7, characterized by the fact that the cutter blade (8) is made of a metallic high-strength elastically deformable or springy blade material.

9. Use pursuant to one or more of the Patent Claims 1 to 8, characterized by the fact that the cutter blade (8) has a steel base material and is provided with a wear-protective covering (15) on its leading flat face (11) consisting of a hard substance or a metal composite containing hard substances or a metal alloy containing a hard substance.

10. Use pursuant to one or more of the Patent Claims 1 to 9, characterized by the fact that the shank (1) has a tubular or cylindrical hollow body (5) at least in the area of the cutter blade holder (4).

Abstract

Shank-end tool with permanently attached wing-like inserts

This invention relates to a shank-end tool that is simple and economical to manufacture, with permanently attached wing-like inserts for the milling-type machining of chipless materials that remains functional with unavoidable frictional wear and with increasing erosion. According to the invention, the shank-end tool is characterized by a shank (1) rotatable around its longitudinal axis (2) that can be connected detachably to a drive device and is provided at its free end section (6) with at least one groove-shaped recess (7) extending in the axial direction and one flat cutter blade (8), which is provided with a non-cutting blade edge (12) on its leading face viewed in the direction of advance (9).

The shank-end tool is used for the manufacture of molds, especially heat-resistant casting molds for the production of metal castings.

FIG. 1

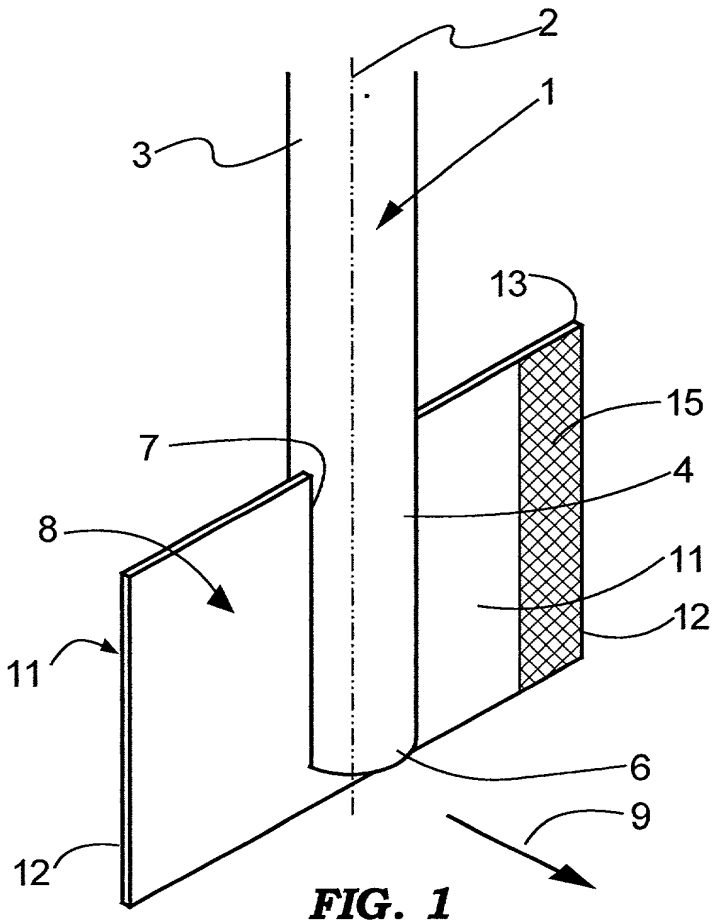

FIG. 1

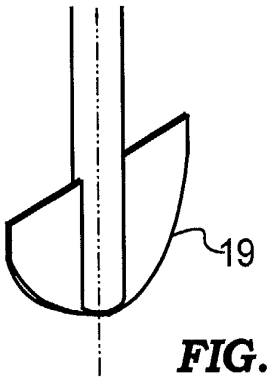

FIG.2

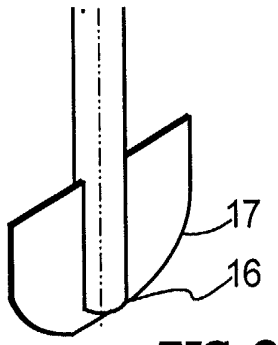

FIG.3

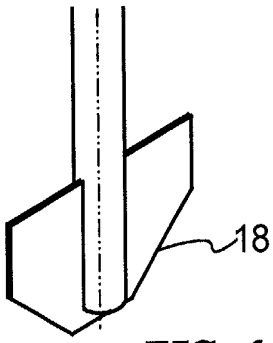

FIG.4

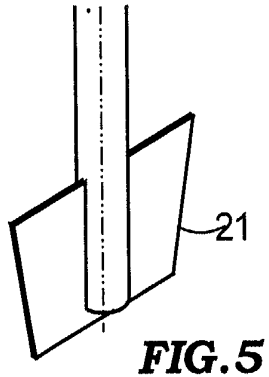

FIG.5

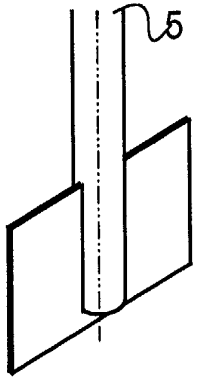

FIG.6

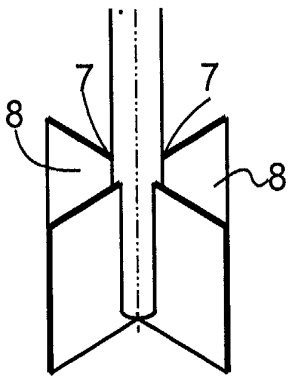

FIG.7

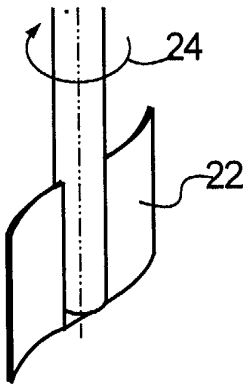

FIG.8

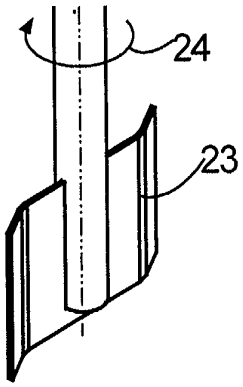

FIG.9

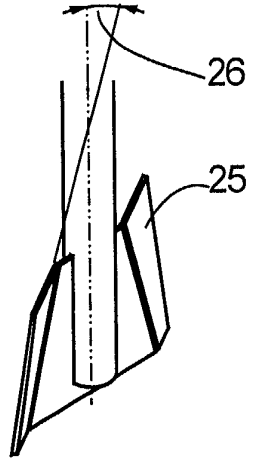

FIG.10

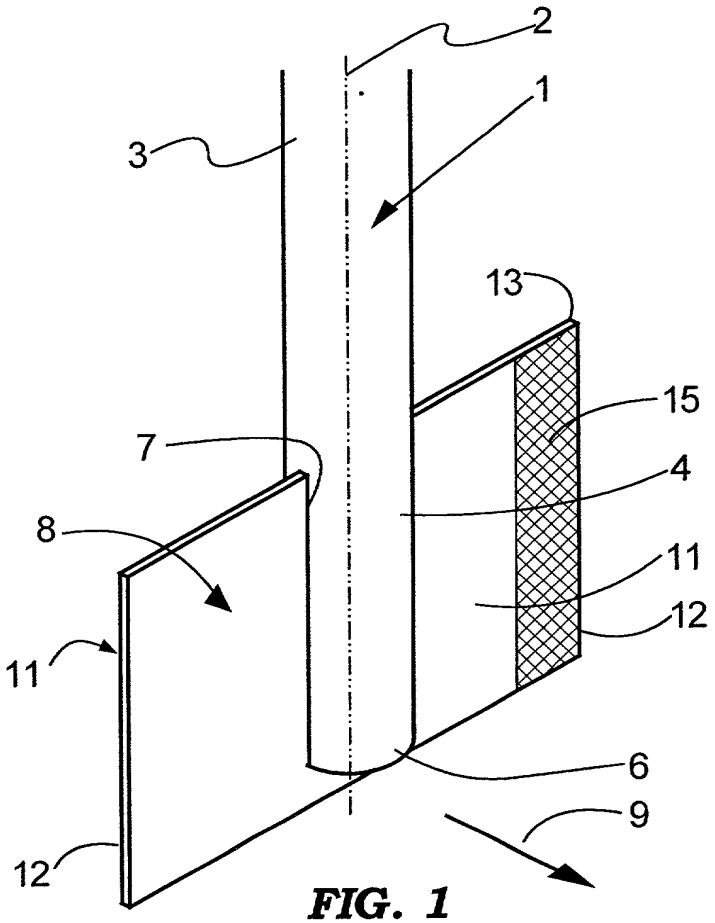

FIG. 1

Declaration and Power of Attorney for Patent Application
English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SHAFT TOOL WITH FIXEDLY DISPOSED WINGLIKE INSERTS

the specification of which

(check one)

[X] is attached hereto.
[ ] was filed on _____ as United States Application No._____ and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
PCT/DE/00/01888 (Number)	PCT (Country)	07/06/00 (Day/Month/Year Filed)	[ ]
P 199 28840.2 (Number)	Germany (Country)	24/06/99 (Day/Month/Year Filed)	[ ]
(Number)	(Country)	(Day/Month/Year Filed)	[ ]

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U.S.C. Section 120 of the United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark office all information known to me to be material to patentability as defined in Title 37, C.F.C., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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